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Use of a modified sonobuoy for studies on wild bottlenose dolphins

C. A. Hunter and R. J. Morris

2 Manwell Drive, Swanage, Dorset BH19 2RB, UK

Abstract

Details are given of modifications which were carried out to a standard sonobuoy so that it could be used as a moored listening device during studies on a resident population of *Tursiops truncatus*. Preliminary trials indicate that this is a useful means of monitoring dolphin movements throughout the day and night.

Introduction

In spite of considerable research interest during the last decade, much is still unknown concerning the social behaviour, feeding habits, territorial range and diurnal activity of marine mammals in the wild. Recently much effort has been focussed on developing radio-tracking devices for use in such studies

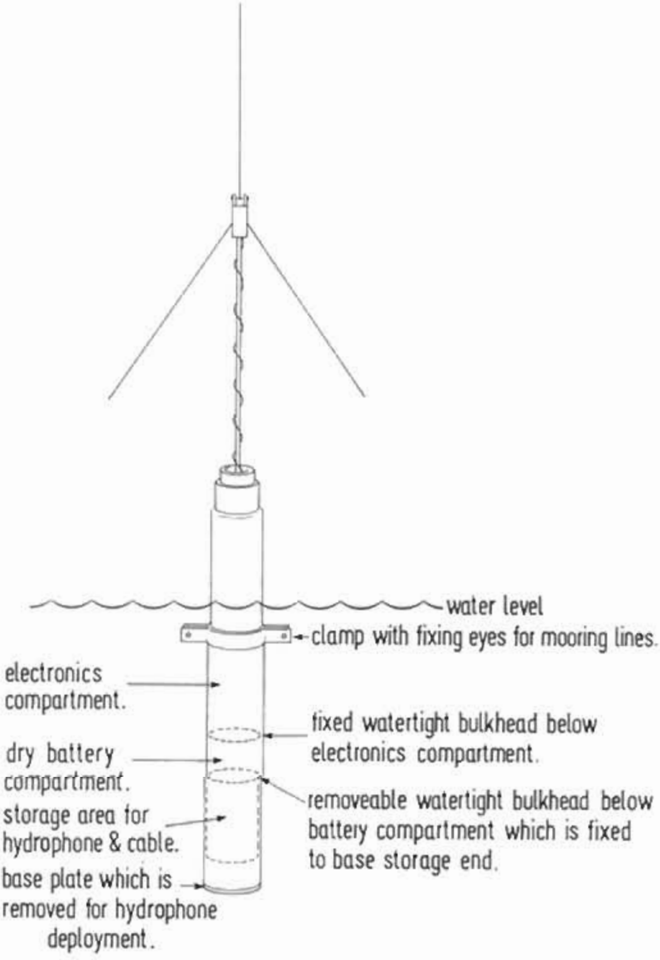

Figure 1. Modified sonobuoy.

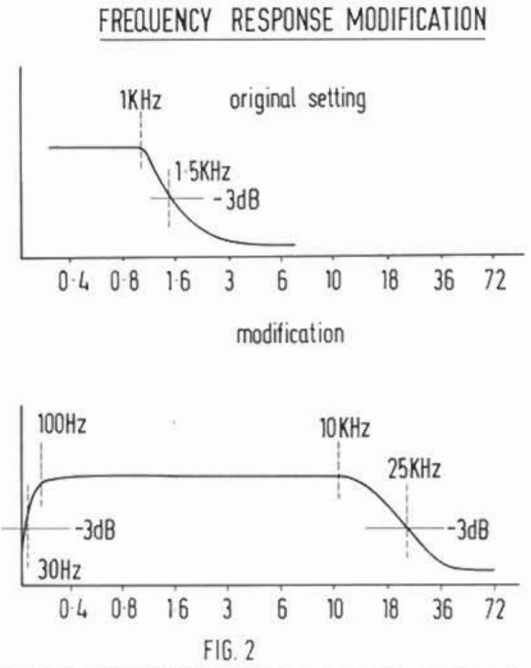

Figure 2. Modification carried out to the sonobuoy's frequency response.

(e.g. Evans, 1971; Gaskin *et al.*, 1975; Watkins & Schevill, 1977; Leatherwood & Evans, 1979; Leatherwood & Ljungblad, 1979). Such devices have great potential for work on the larger marine mammals where the transmitter, incorporated in a small harpoon, can be easily implanted into the blubber with little harm or disturbance to the animal. There are many problems however regarding the application of such techniques to studies of the smaller marine mammals such as the dolphin. First, the animal must be caught and the beacon fixed to the animal's body by means of a harness, a bolt through the dorsal or pectoral fin, or, in the case of animals with fur, glue. Such methods will inevitably cause considerable stress and possibly pain to the animal. Second, many of the smaller marine mammals frequent inshore areas commonly used by fishermen. Fixtures on the body such as harnesses or bolt-on devices can easily become tangled in nets and long lines causing the animal to drown. Third, once a fixed device has been attached to a particular animal, it is not always possible to ensure that the device self-releases after a given time, or to recapture that animal after the study period in order to remove the beacon. The animal is then left with a permanent handicap. Many of these problems could be alleviated if non permanent methods of attachment could be developed such as suction cups, however tests on dolphins using this type of attachment have so far not proved successful.

During our studies of wild, resident dolphins around the U.K. coast (Lockyer *et al.*, 1978; Lockyer & Morris, 1985, 1986, 1987a,b; Morris *et al.*, 1985) we have attempted to carry out the field work in as unobtrusive a manner as possible. We believe that this is in the best interests of the animals and also is much more likely to produce information on normal behaviour. As a consequence we have attempted to develop a range of non-invasive observational techniques. For studies on resident populations of highly vocal marine mammals such as dolphins we believe a useful alternative to the use of fixed radio beacons may be moored listening devices. This paper describes one such piece of equipment, based on a standard sonobuoy.

Experimental

Sonobuoys were designed well over 20 years ago primarily for submarine detection. Since that time they have found many oceanographical and geophysical applications. The buoy is able to collect acoustic data from its immediate vicinity and then transmit this data to a receiving station either onshore or on a ship. They are designed to be disposable units with a maximum operational life of 4–8 hours and have a frequency response which generally lies between 5 Hz and 1.5 kHz in their standard military form.

For use in marine mammals studies it quickly became evident that a number of important modifications to the basic sonobuoy would be necessary. We needed a re-useable unit which could be moored, would give at least 24 hours listening during any one deployment and would have a fairly broad frequency up to at least 15 kHz.

With these considerations in mind we started with the basic Seismic sonobuoy (type SB6 E4) manufactured by Ultra Electronics (Greenford, Middlesex). The unit is powered by a sea water battery which free floods and vents via ports in the side wall and antenna tube. A scuttling mechanism is activated after a selected time (2–8 hours). The first important modification was to do away with the sea water battery and make a watertight compartment for a replaceable dry battery pack, which could provide enough power for at least 24 hours continuous transmission. All the vents and ports were sealed and an additional bulkhead added below the battery compartment. The battery compartment was made watertight by means of a wide, soft 'O' ring seal on the bulkhead which was also fitted with a gland for the hydrophone cable (Figure 1). By attaching this bulkhead to the base unit which stores the hydrophone and hydrophone cable, the whole unit (base plus bulkhead) could be removed for the replacement of the battery pack without disturbing the upper, main electronics compartment. An air bleed screw in

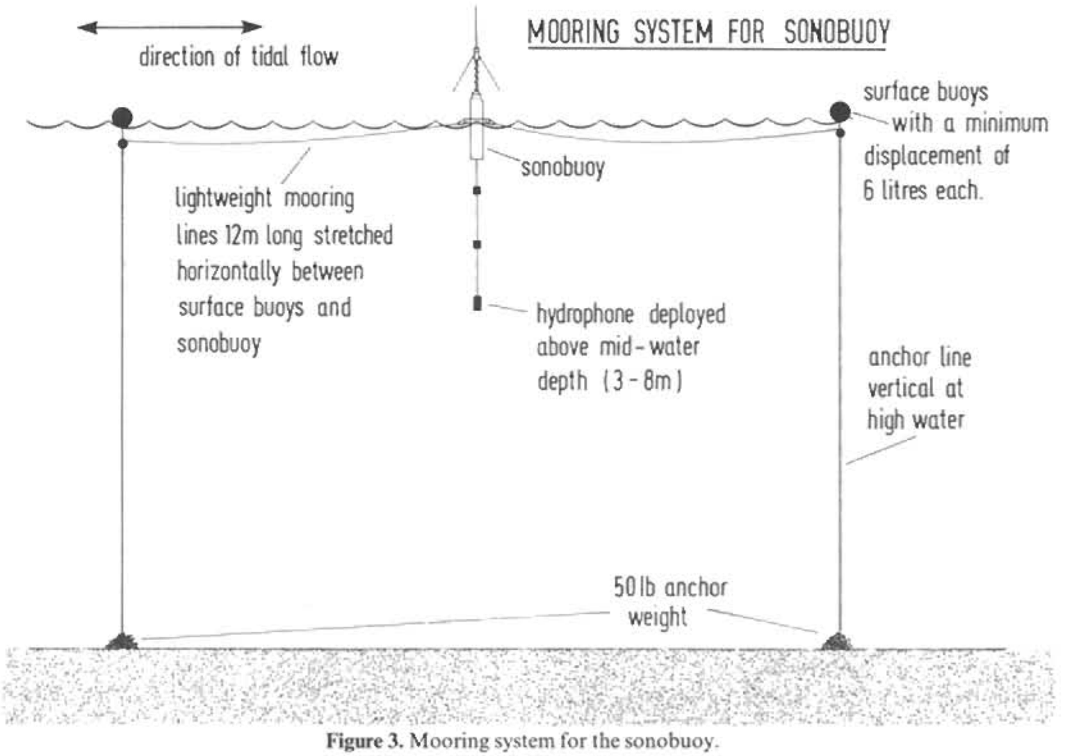

Figure 3. Mooring system for the sonobuoy.

the bulkhead was however necessary due to the 'O' ring seal on the bulkhead.

Battery requirements are 10.5 V for at least 24 hours. There is sufficient space in the battery compartment for seven 'D' size cells connected in series. By using manganese alkaline cells with a capacity of 15 AHr and assuming a continuous current consumption of 330 mA (maximum measured), it was calculated that battery life should be in excess of 30 hours. Such a battery pack weighs 1 kg but taking into account the weight of the removed sea water battery and the buoyancy gain from the extra air space created by the sealed battery compartment, it was apparent that the actual buoyancy of the unit as a whole would not be unduly affected.

The sensitivity of the sonobuoy was found to be too high for shallow water, inshore use and in addition the frequency response was too low for recording dolphin emissions, being tailored to lie between 5 Hz and 1.5 kHz and falling off at 6 dB per octave above this point (Figure 2). As information on sound pressure levels from dolphins and their frequency ranges is scarce, a response was chosen so as not to unduly limit the frequency range, whilst also taking into account the type of recording equipment available. A compromise is necessary in order to avoid an unduly large modulation index with consequent problems in succeeding RF stages. When more information is available, further thought must be given to rationalizing the modulation requirements. By changing the coupling capacitors in the sonic amplifier the frequency response was broadened to give a final response from 30 Hz to 25 kHz at -3 dB points (see Figure 2).

The scuttling mechanism was removed with the exception of the 3-way scuttle timer switch which was then used to provide a switched attenuator with factors of 1, 10 and 100 approximately. This was located in the bottom electronics bulkhead, just above the battery pack and accessible from the battery compartment.

As most of the planned work was inshore in waters of 10–30 m depth the hydrophone cable and rubber spring was shortened to give a variable hydrophone deployment depth of 3–8 m.

Finally, in order to moor the sonobuoy, a system was designed whereby tangling and damage to the hydrophone array would be minimal and the device would be able to safely survive at least a moderate sea state. A detachable clamp with fixing holes for mooring lines was attached at the water line of the buoy (Figure 1). The mooring system is shown in Figure 3 and consists of two vertical anchor lines running to surface buoys and horizontal mooring lines holding the sonobuoy in place between the two surface buoys. The whole array is set into any tidal flow and the length of the anchor lines is determined by the water depth at high water.

Results

Modified units have been successfully deployed off the west coast of Wales between October 1986–March 1987 at fixed moorings in depths of 10–20 m. The system has survived fairly severe sea states and can be operated continuously for well over 24 hours on one battery pack. Individual units have been re-used for up to 8 separate deployments and it is envisaged that the potential number of re-deployments per unit will be much higher than that number. For inshore use it has been found best to operate the sonobuoy on the greatest attenuation (× 100). At this setting it is possible to pick up a wide variety of dolphin emissions from a range of at least 200–300 m. The main limiting factor is the amount of background noise (breaking waves, pebbles, boat engines etc.) in the area, and for this reason care must be taken in the choice of mooring sites. In the light of this a future modification will be to reduce the overall system gain by a further factor of 10.

Conclusion

Preliminary trials of these modified sonobuoys in the home range of a resident group of bottlenose dolphins off West Wales has shown that they can be used as a means of monitoring dolphin movement and activity in the area during both day and night. They have also proved to be a valuable method of recording a wide range of the animal's acoustic emissions.

Acknowledgements

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